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River Landscapes

quiz

Key Terms

Cross profile – The side to side cross-section of a river channel and/or valley.

Long profile – The gradient of a river, from its source to its mouth.

Deposition – The process of transported material being dropped.

Estuary – The tidal mouth of a river where it meets the sea.

Flood plain – The flat area forming the valley floor either side of a river.

Levèe – An embankment of sediment along a river caused by flooding.

Saltation – Particles bouncing along the river bed.

Suspension – Fine solid material held in the water while the water is moving.

Meander – A bend in a river.

Oxbow lake – A curved lake formed when a river cuts off a meander.

Pools – Areas of deep water and greater erosion in a river.

Riffles – Areas of shallow water created by the deposition of coarse sediment.

River cliff – Cliff formed by lateral erosion on the outside bend of a meander.

Slip-off slope – A gently sloping river beach formed on the inside of a meander.

Agriculture – Farming, including growing crops and rearing animals.

Deforestation – The action of clearing an area of trees.

Flood risk – The probability of flooding and the impact if it occurred.

Afforestation – The establishment of trees in an area with no previous cover.

Flood warnings and preparation – An alert system to the risk of flooding.

Floodplain zoning – Land in a river valley is used in a way to minimise flooding.

Abrasion – Rocks carried along by the river wear down the river bed and banks.

Attrition – Rocks transported by the river collide and become smaller and rounded.

Erosion – The wearing away of rock and soil found along the river bed and banks.

Hydraulic Action – The force of water compressing air in cracks, weakening river banks.

Lateral erosion – Sideways erosion by a river on the outside of a meander.

Solution – Soluble particles are dissolved into the river and carried in the water.

Vertical erosion – Downward erosion of a river bed.

Waterfall – A sudden descent of a river or stream over a vertical or very steep slope in its bed.

Fluvial landforms – Landforms formed by river processes.

Gorge – a narrow, steep sided valley, often formed as a waterfall retreats.

Interlocking spurs – Ridges projecting out on alternate sides of a valley.

Plunge pool – A deep depression at the base of a waterfall.

Channel straightening – Removing meanders to straighten a river channel.

Dam – A structure across a river to control the flow of water.

Embankments – Building up the banks of a river creating levees or building walls.

Flood-relief channel – An artificial channel to divert water.

Hard engineering – building structures, to control natural processes locally.

Reservoir – An artificial lake where water is stored.

River Restoration – Returning an engineered river to its natural state.

Soft Engineering – Adapting to a river and learning to live with it.

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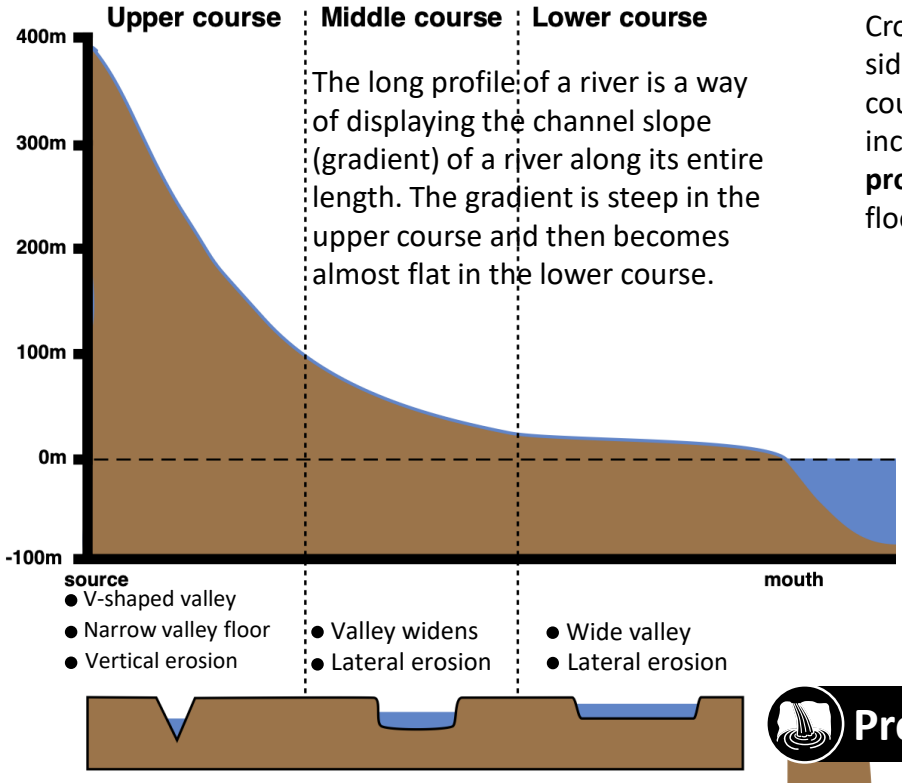
River Profiles & Erosion

quiz

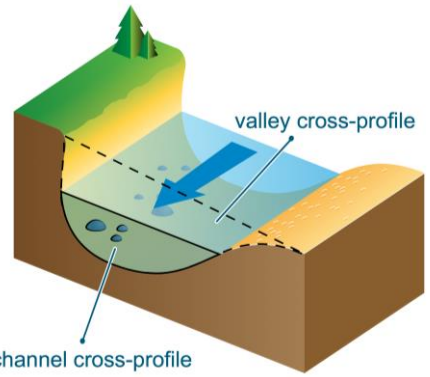
Long Profile



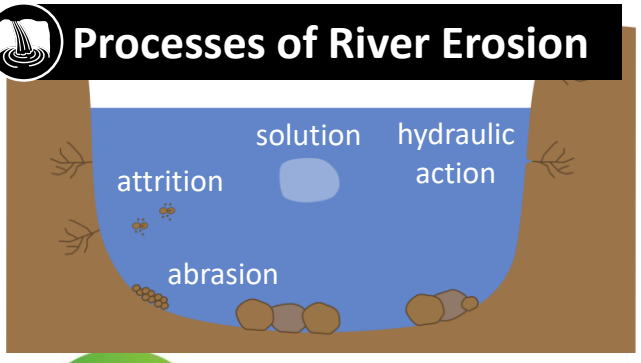
The long profile of a river is a way of displaying the channel slope (gradient) of a river along its entire length. The gradient is steep in the upper course and then becomes almost flat in the lower course.

Cross Profile

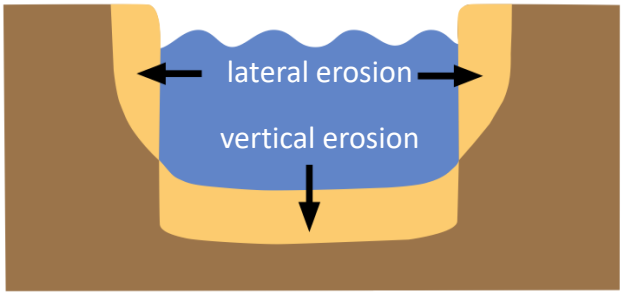
Cross profiles are a cross-section, taken sideways at certain points in the river's course. A **channel cross-profile** only includes the river whereas a **valley cross-profile** includes the channel, the valley floor and the sides of the valley.



Processes of River Erosion



Lateral and Vertical Erosion



Vertical erosion, through hydraulic action and abrasion is the dominant process of erosion in the **upper course**.

Horizontal erosion, through hydraulic action and abrasion occurs in the **middle course** of the river. Attrition also occurs here.

In the **lower course** meander migration widens the valley.

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Erosional Landforms

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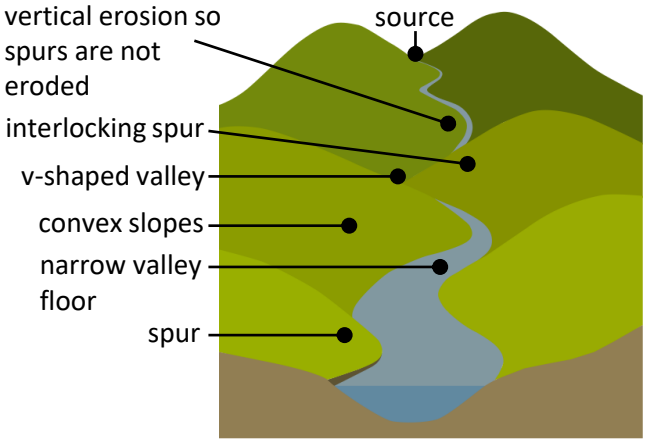
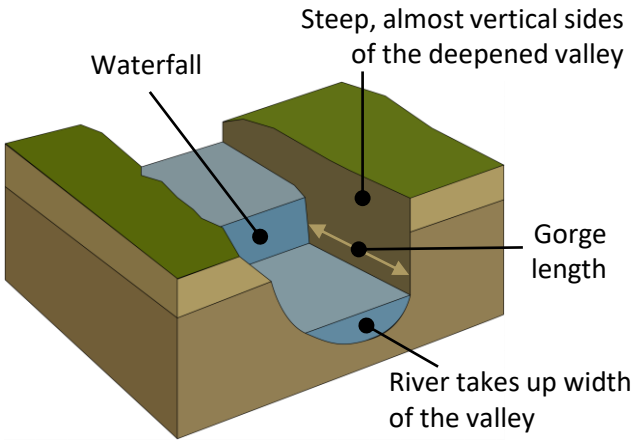
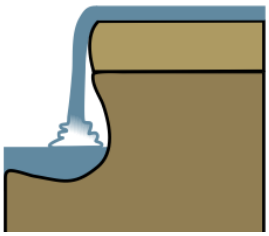
Interlocking Spurs



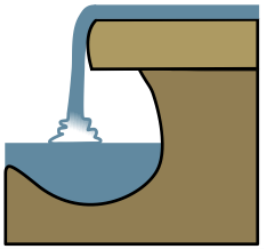
Gorge



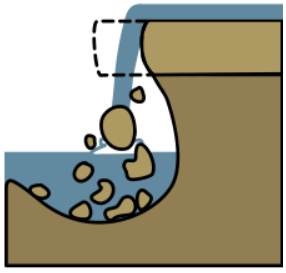
Waterfall



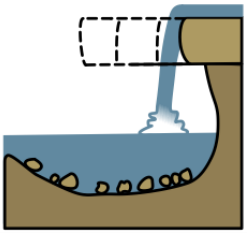
1. Waterfalls occur in the upper stage of a river where a band of hard rock overlies a softer rock. Falling water and rock particles erode the soft rock below the waterfall, creating a plunge pool.



2. The soft rock is undercut by erosional processes e.g. hydraulic action and abrasion creating a plunge pool where water and debris swirl around eroding the rock creating an overhang.



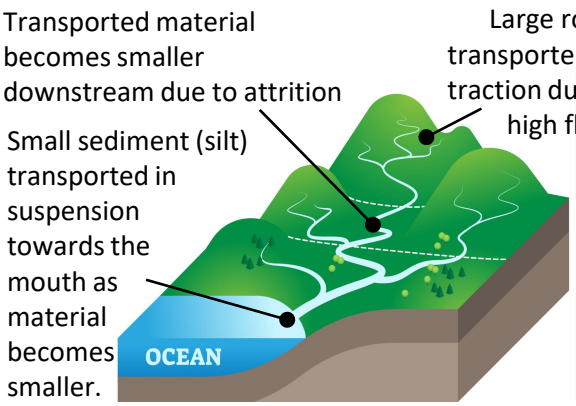
3. The layer of hard rock overhang above the plunge pool collapses as its weight is no longer supported.



4. Erosion continues and the waterfall retreats upstream leaving behind a gorge.

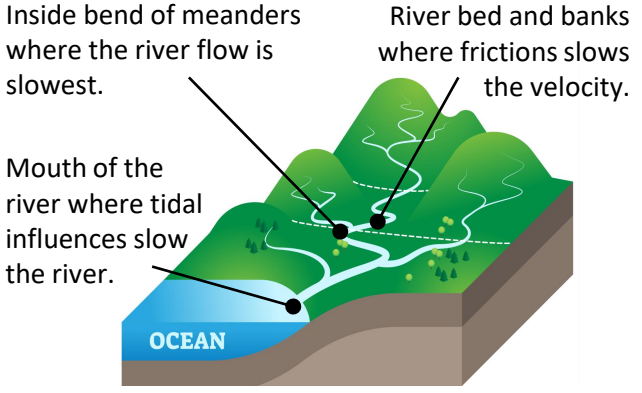
River Transportation

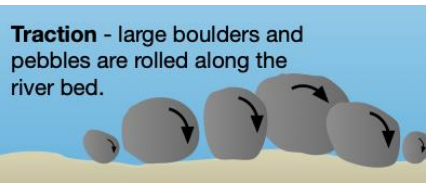
Transportation is affected by river velocity.

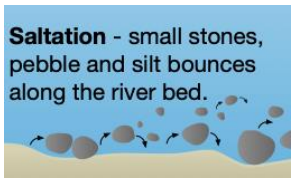


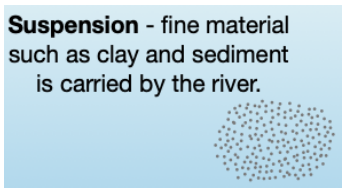
River Deposition

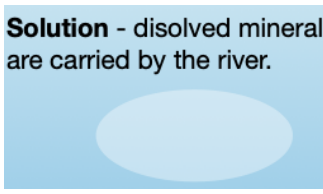
Deposition occurs when a river loses velocity.











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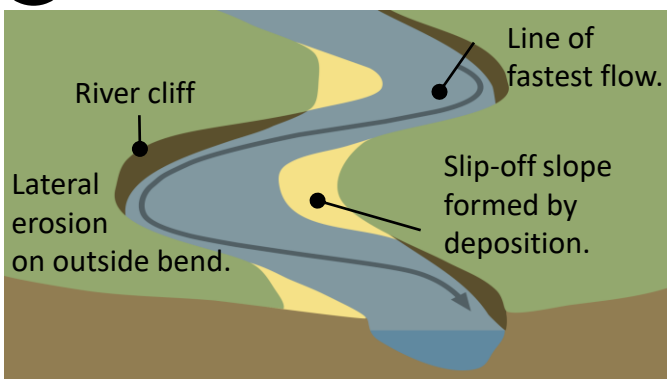
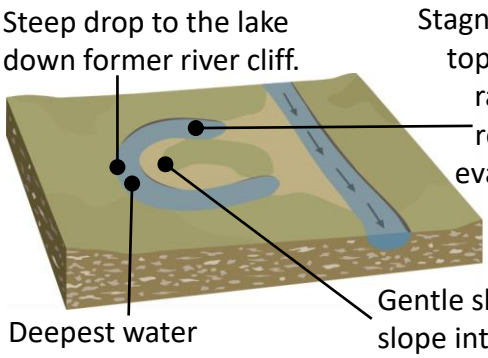
Erosion & Depositional landforms

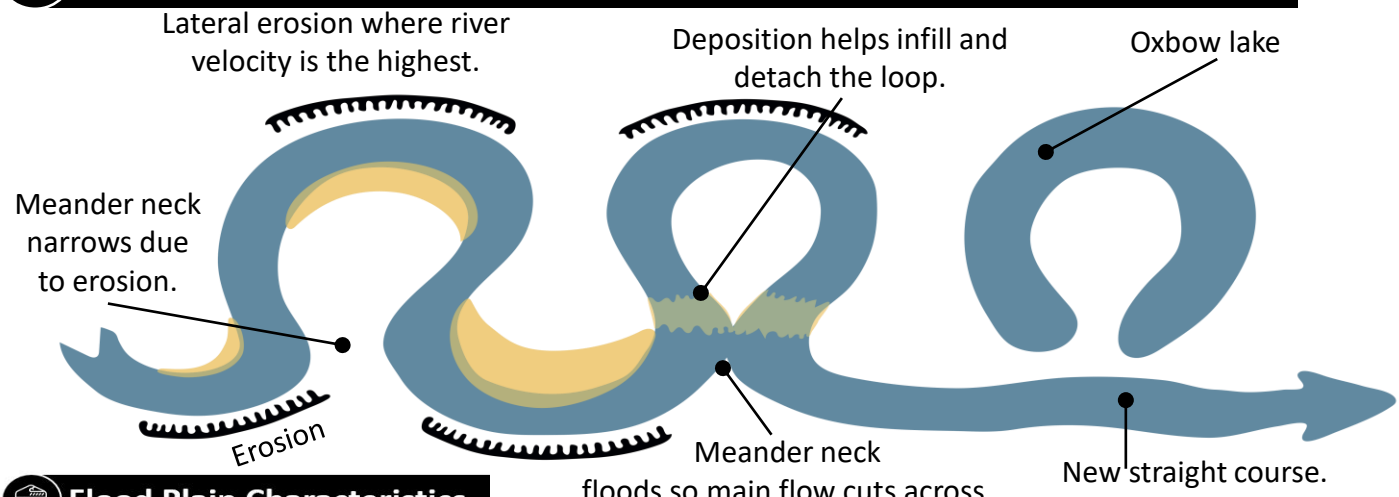
Mender characteristics



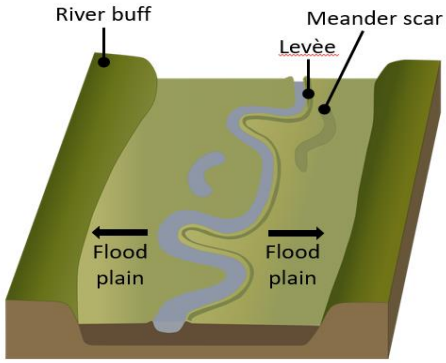
Oxbow lake characteristics



The formation of an oxbow lake

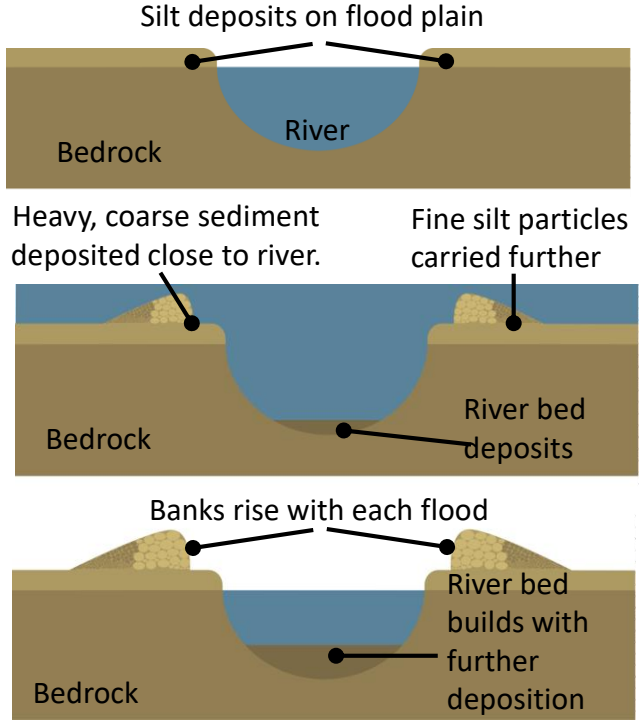


Flood Plain Characteristics

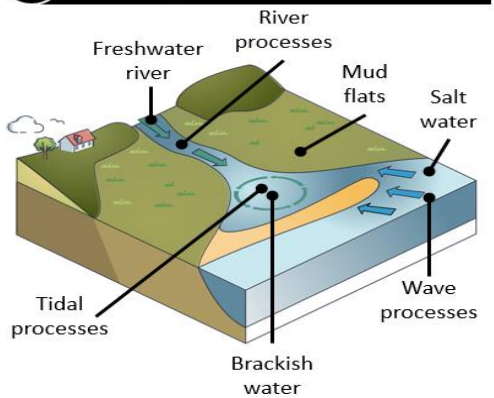


Flood plain widens due to meander migration.

Levèe Formation



Estuary Characteristics



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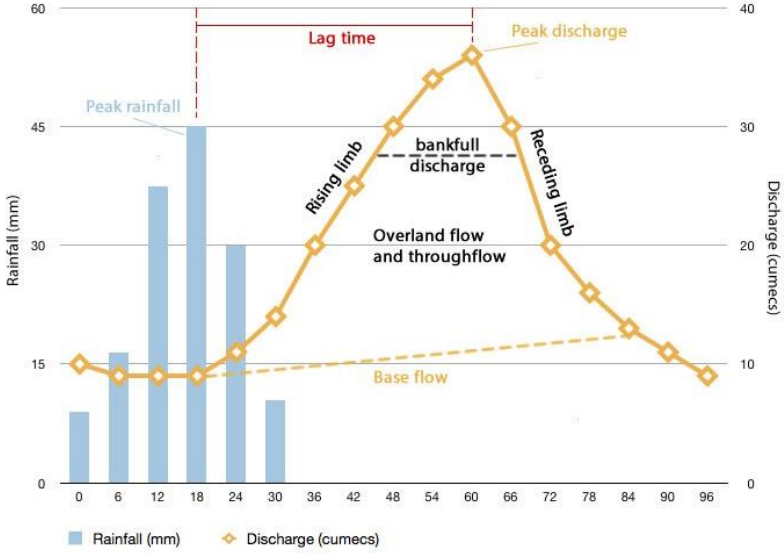
Hydrographs & Flooding

quiz



Baseflow – The normal flow of a river when sustained by groundwater flow.

Bankfull discharge – Level of discharge above which a flood will occur.

Falling limb – The reduced discharge following the peak discharge.

Hydrograph – A graph showing river discharge, related to rainfall, over time.

Lag time – The time difference between peak rainfall and peak discharge.

Peak discharge – The highest recorded discharge following a rainfall event.

Peak rainfall – The highest amount of rainfall per time unit (highest bar).

Flashy vs Flat Hydrograph

Flashy – rapid response hydrograph posing a high flood risk.

- Steep slopes
- Impermeable rock
- Heavy/prolonged rainfall
- Urbanisation
- Deforestation

Flat – slow response hydrograph posing a low flood risk.

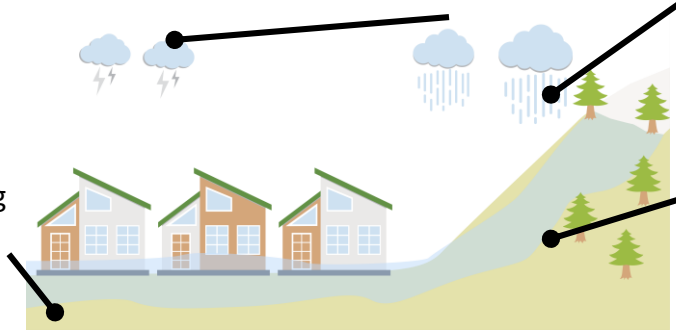
- Gentle slopes
- Permeable rocks
- Drizzle
- Deep, dry soils
- Afforestation

Physical Causes

Heavy rainfall – water arrives too quickly to infiltrate the soil increasing surface run-off. Water rapidly reaches river channel.

Prolonged rainfall - Soil becomes saturated. This increases surface run-off as rainfall can no longer infiltrate the soil. Flood risk increases.

Geology - Impermeable surfaces e.g. clay and granite reduce infiltration leading to greater surface run-off. The risk of flooding increases as water reaches the river channel quickly, increasing discharge and the risk of flooding.



Relief - The steeper the slope the more rapid the flow of water into a river channel, increasing the risk of flooding.

Human Causes of Flooding

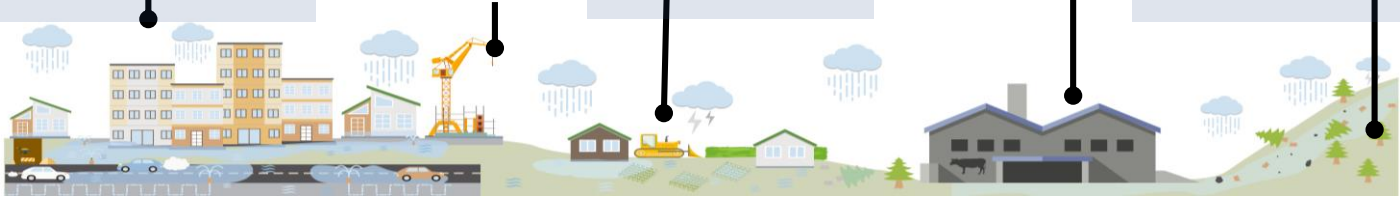
Disappearing gardens
The growth in the use of impermeable surfaces increases run off e.g. installing new drives and paving gardens.

Urbanisation
Urbanisation leads to new roads, houses, and other developments. This increases surface run off.

Agriculture
Field sizes have increased, loss of hedges means there is less interception increasing the risk of flooding.

Disappearing fields
Large scale farming leads to fields being replaced by large sheds

Forestry
Deforestation reduces interception and and roots no longer take water from the soil.



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River Management

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Soft Engineering

Adapting to a river and learning to live with it. It working with nature. It is cheaper, but often less effective than hard engineering strategies.

Hard Engineering

The construction of structures built to control the flow of water and reduce flooding. They work against nature. Decisions about hard engineering solutions are based on cost-benefit analysis.

Flood Warnings and Prep

Benefits

- Cheap and dependent on communications
- If warned in advance people can protect valuables
- Ensures safety without the cost of hard engineering.

Costs

- Only effective if people listen & take action
- Not everyone has access to digital communications
- Floods continue to occur

Dams and Reservoirs

Benefits

- Generate electricity
- Controlled release of water so less flood risk.
- Source of drinking water

Costs

- Expensive
- People displaced as large area of land flooded
- Sediment is trapped behind the dam and ecology downstream can be affected.

Planting Trees

Benefits

- Interception reduces surface run-off
- Increases carbon storage
- Creates new habitats and increases biodiversity
- Relatively inexpensive

Costs

- Loss of potential grazing land
- Changes the appearance of the countryside
- Can increase soil acidity

Channel Straightening

Benefits

- Water moves quickly away from urban areas
- Navigation improved
- Reduces flood risk in prone areas

Costs

- Expensive
- Looks unattractive
- Increases flood risk downstream
- Aquatic habitats affected

River Restoration

Benefits

- Creates wetland habitats & increases biodiversity
- Reduces the risk of flooding downstream

Costs

- Possible loss of agricultural land
- Can be very expensive

Embankments

Benefits

- Increases river capacity so reduced flood risk
- New habitats created
- Provides walkways

Costs

- Looks unattractive
- Expensive
- If embankments fails flooding more serious

Floodplain Zoning

Benefits

- Impermeable surfaces are not increased
- Low-cost, as it only involves administration
- Traditional water meadows protected
- Creates a welcome green space

Costs

- Limited impact as most floodplains are developed
- House prices inflated due to lack of housing stock
- Other greenfield sites affected

Flood Relief Channels

Benefits

- Flood risk reduced near urban areas
- New habitats created
- Recreation e.g. fishing and paddle boarding

Costs

- Expensive
- Ongoing maintenance
- Looks unattractive if concrete used

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Case Study - The River Tees

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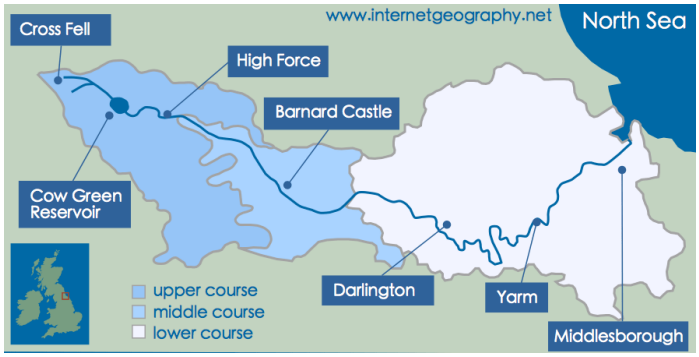
River Tees - Location

North east of England. It's source is in the Pennine Hills near Cross Fell. It flows east 128km to the North Sea near Middlesborough.



River Landforms on the River Tees

High Force

Waterfall and gorge

20m drop into a plunge pool at High Force. A gorge it has formed as it retreats. Resistant igneous rock lies on top of less resistant limestone. The limestone is undercut and an overhang is left which eventually collapses forming a gorge as the waterfall retreats.

Yarm

Meanders, levees and floodplains

In its lower course, the River Tees has extensive meanders, particularly between Darlington and Yarm. The meandering river has widened the river valley to create a significant floodplain. There are also levees along this stretch of the River Tees that have formed when this low-lying area has experienced flooding in the past.

River management on the River Tees

Cow Green Reservoir

- Cow Green reservoir was built in 1970 to provide water for the growing industries on Teesside.
- It is a regulating reservoir, storing water in times of plenty and releasing enough for the needs of industry in times of low flow.
- It can hold back water during times of flood.

Flood Warnings

- The Environment agency issue flood warning to residents in the local area that are at risk.
- Warnings can allow residents to prepare for a potential flooding event
- Improved flood warning systems liaise with the Meteorological Office, police and other emergency services to coordinate responses.

Dredging the Tees

- The lower parts of the Tees estuary are dredged (sediment is removed) periodically to improve navigation by maintaining a deep-water channel.
- There has also been some dredging in the upper parts of the estuary to reduce the flood risk - it increased the capacity of the channel.

Tees Barrage

- The Tees Barrage (a man made barrier across a river) -The aim of the Tees Barrage was to improve the water quality and recreational value of 22km of the lower Tees.
- The barrage was completed in 1995 and cost £54 million.
- The 22km stretch of river between Yarm and Stockton is now kept permanently at high tide. The water is fresher and cleaner as it does not mix with the tidal salt water in the lower estuary.
- The barrage also reduces the risk of flooding at very high tides or during a storm surge. The barrage has acted as a catalyst for £500 million of investment in offices, housing, educational, leisure and shopping facilities.

Yarm Flood Defences

- Since the 1995 flood event a new flood defence scheme costing £2.1 million has been built.
- New development has discouraged building on low-lying and flood-prone land (land is used for activities not damaged by inundation e.g. playing fields, parks, urban forests/walks etc.)

In the Yarm area the Environment Agency have;

1. Put in Reinforced concrete walls with metal flood gates for access by people and vehicles
2. Used Earth Embankments
3. Put in Gabions to protect walls and embankments from erosion

Included Fishing platforms, street lighting and replanting to improve the environment Kept building materials in keeping with existing architecture